Ontario Geological Survey

Northern Ontario
Engineering Geology Terrain Study 29

TARADALE AREA

(NTS 42F/NW)

Districts of Algoma, Cochrane, and Thunder Bay

Compliments of
ONTARIO NORTHERN DEVELOPMENT
MINISTRY OF NORTHERN AFFAIRS AND MINES
Not for resale

John F. Gartner and B.F. McQuay

1980

Ontario

Ministry of Natural Resources
Hon. James A.C. Auld, Minister
Dr. J.K. Reynolds, Deputy Minister

Ministry of Northern Affairs
Hon. Leo Bernier, Minister
Art Herridge, Deputy Minister

93-02314/

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Printed in Canada

THIS PROJECT WAS FUNDED BY
THE ONTARIO MINISTRY OF NORTHERN AFFAIRS
AND IS MANAGED BY
THE ONTARIO MINISTRY OF NATURAL RESOURCES

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Orders for publications should be accompanied by cheque or money order payable to the *Treasurer of Ontario.*

ISSN 0709-4671
ISBN 0-7743-4305-2

Parts of this publication may be quoted if credit is given. It is recommended that reference to this report be made in the following form:

Gartner, John F. and McQuay, D.F.
1980: Taradale Area (NTS 42F/NW), Districts of Algoma, Cochrane, and Thunder Bay; Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 29, 15 p. Accompanied by Map 5082, scale 1:100 000.

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MAP
(accompanying report)

Map 5082 (coloured) - Northern Ontario Engineering Geology Terrain Study, Data Base Map, Taradale (NTS 42F/NW). Scale 1:100 000.

Northern Ontario

Engineering Geology Terrain Study 29

TARADALE AREA

(NTS 42F/NW)

Districts of Algoma, Cochrane,
and Thunder Bay

by

John F. Gartner[1] and D.F. McQuay[2]

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Taradale area, Districts of Algoma, Cochrane, and Thunder Bay. The area, which covers NTS block 42F/NW, lies between Latitudes 49°30'N and 50°00'N and Longitudes 85°00'W and 86°00'W. This report forms part of a series of publications which provide similar terrain data for some 370 000 km^2 of northern Ontario.

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5082, accompanying this report).

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[1]Consulting Engineering Geologist, Gartner Lee Associates Limited, Markham, Ontario.

[2]Earth Scientist, Gartner Lee Associates Limited, Markham, Ontario.

Manuscript approved for publication by the Chief, Engineering and Terrain Geology Section, October 19, 1979. This report is published with the permission of E.G. Pye, Director, Ontario Geological Survey.

Interpretation of existing black and white aerial photographs, at scales of approximately 1:54 000, was the primary method of obtaining this terrain information. The interpretation was checked with published and unpublished literature which documented previous field visits and observations. During the summer of 1978, roads in the area were traversed and observed terrain conditions recorded as further verification of the office studies. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common format for the entire map series. This legend is shown on the accompanying Data Base Map. Further information on the mapping techniques, legend format, and possible uses of the terrain data is available in the "Ontario Engineering Geology Terrain Study Users' Manual" (Gartner, Mollard, and Roed 1980), a companion publication to this series of maps and reports.

2.0 GEOLOGICAL SETTING:

2.1 BEDROCK:

Early Precambrian rocks underlie the entire map-area. Relief in the bedrock terrain is generally low, with hills seldom exceeding 15 to 20 m in height. Quaternary deposits are widespread and form a thick mantle over much of the bedrock, especially in the northern and eastern parts of the area.

The west-central part of the map-area, in the vicinity of Klotz and Kassagimini Lakes, is underlain by a small belt consisting of metasediments and mafic to intermediate metavolcanics in roughly equal amounts. Bedrock throughout the remainder of the area consists of felsic intrusive and metamorphic rocks (mainly undifferentiated) and metasedimentary and metavolcanic migmatites. Numerous northwest-trending and several northeast-trending diabase dikes cut all other rocks (Ayres *et al.* 1971; Innes and Ayres 1971).

Several occurrences of gold and copper have been reported, mainly from the metavolcanics. The metavolcanic-metasedimentary belt has medium mineral potential, particularly for gold and copper, while the potential of the remainder of the area is rated as "least" (Springer 1978).

2.2 QUATERNARY:

There is a considerable amount of drift covering the bedrock in the Taradale area. The thicker drift deposits, which are common in the northern and eastern parts of the area, consist of glaciolacustrine silt and clay. A clay till which occurs in the northeast corner of the area represents the deposits left by a late re-advance of the ice sheet. Glaciofluvial deposits are not abundant and only thin deposits of glacial till occur in the areas of bedrock terrain.

Most of the overburden was deposited during the retreat of the Wisconsinan ice sheet. As the ice front retreated to the north, waters of Glacial Lake Barlow-Ojibway inundated the area and deposited thick sequences of clay, silt, and some sand. Approximately 8 000 years ago, the ice sheet made two weak and relatively localized advances into the area. During these readvances, known as Cochrane I, and Cochrane II, the ice moved over the former bed of Glacial Lake Barlow-Ojibway, depositing a silty clay till over the glaciolacustrine materials.

The extensive deposits of fine-grained materials are often associated with level to gently undulating topography. As a result of this combination of conditions, large, wet, poorly drained areas occur, throughout the area.

3.0 ENGINEERING TERRAIN UNITS:

3.1 BEDROCK LANDFORMS:

3.1.1 Description:

Rock knobs (RN) comprise most of the bedrock terrain units in the Taradale area. The relief in these units is low, generally less than 15 m. However, even with this relatively low relief, the terrain is locally rugged and jagged.

A mantle consisting of ground moraine and, in some cases, glaciolacustrine sediments is associated with the bedrock terrain. These overburden materials are usually less than 1 m in thickness near the crests of the bedrock hills but often thicken to as much as 3 to 5 m on the flanks and in some of the valleys between the hills. The till is sandy in texture and cobbles

and boulders are common. The action of the glacial lakes has resulted in washing of the till and deposition of stratified sand and silt on surface. Localized organic deposits often occur in poorly drained areas between the bedrock highs.

A typical map symbol depicting this terrain unit is:

$$\frac{\text{RN(tMG,sLP,pOT)}}{\text{Luw-M}}$$

This indicates that the dominant landform in the area is rock knobs. These form undulating terrain of low relief, generally less than 15 m. Ground moraine and sandy lake plain deposits occur as subordinate units in topographic lows and on the flanks of bedrock hills. The land surface has been washed and modified by later glacial lake action. Organic terrain is common in low areas between bedrock highs.

3.1.2 Significance:

RESOURCES: Portions of the rock can be used for crushed stone purposes, but detailed evaluations of suitability for aggregate use would be required. Ground water resources within the rock will be limited to fissures, fractures, and faults. The occurrence of aquifers is unpredictable and the terrain has only fair potential for ground water supplies.

GENERAL CONSTRUCTION: The major constraint in terms of construction is the presence of bedrock close to the surface. This means that below-ground excavations will probably require blasting. Site-grading will be expensive and rockfills will be necessary in grading works. Foundation conditions should be excellent on the bedrock, but route alignments will require rock cut-and-fill operations. However, since the relief is low (generally less than 15 m), the need for highway cuts and fills may be minimal within this terrain.

Because of the shallow drift cover and the complex bedrock slopes, development activities are generally more difficult, and hence more expensive, than in areas of thicker overburden. Management of the land for most uses would be difficult. The variable and sometimes steep rock slopes, combined with the shallow soil cover, will make the terrain sensitive to surface erosion, especially when cleared of vegetation.

WASTE DISPOSAL: The bedrock terrain is generally not amenable, in its natural state, to the disposal of waste, whether it be garbage, septic tank effluent, or industrial liquid waste. Development of lagoons or tile fields would require extensive grading of rock materials and importation of suitable soil fill. Fractures in the bedrock could act as conduits for migration of effluents, and impact on surface drainage courses could be significant.

3.2 MORAINAL LANDFORMS:

3.2.1 Description:

Ground moraine (MG) covers most of the bedrock but only attains significant thicknesses in the northeast and in scattered patches along the southern boundary and in the west-central portion of the area.

The largest expanse of ground moraine, which occurs in the northeast corner of the area, is composed of silty clay till. Exposures of this material indicate thicknesses of 1 to 5 m. The clay till contains very few stones and is often underlain by glaciolacustrine clay and silt. A typical terrain unit symbol is

$$\frac{\text{tcMG,cLP(pOT,RN)}}{\text{Lu-M}}$$

Interpretation of this symbol indicates that the area is underlain by clay till of ground moraine origin and clay of glaciolacustrine origin. Organic terrain and bedrock knobs occur as subordinate landforms. The terrain has low, undulating relief and surface drainage is mixed wet and dry.

The remainder of the ground moraine areas are composed of sandy and stony till overlying the bedrock. These areas represent a local thickening of the till sheet, which may have been modified by lake action in the past. Thus, the symbols on the map show ground moraine as being the dominant landform. Subordinate landforms include lake plain sediments, organic terrain, and bedrock knobs. Relief is usually low and the land surface is undulating and reworked as previously described. Surface

drainage is dry to mixed. Typical symbols depicting the smaller areas of ground moraine are:

$$\frac{\text{tMG/R(pOT,RN)}}{\text{Lup-D}} \qquad \frac{\text{tMG(mLP,pOT,RN)}}{\text{Luw-D(M)}}$$

3.2.2 Significance:

RESOURCES: The morainal areas in the Taradale area have very little potential as sources of sand and gravel. Small local pockets of aggregate materials may occur where the till has been locally washed and modified by glacial lake action. The sandy till areas, where they are sufficiently thick, may have potential as a local source of borrow material. In some localities, small eskers may be buried beneath the clay till of the Cochrane readvance.

Ground moraine is not usually considered a good potential source of ground water. An exception to this would occur where the till is sufficiently thick and is underlain by sand and gravel.

GENERAL CONSTRUCTION: Construction conditions in the clay till ground moraine are generally rated as fair to poor, while conditions in the sandy till are rated as moderate to good. Within the clay till, there would be few problems with excavation under dry conditions. However, wet weather handling of the material could be very difficult because of high soil plasticity. Detailed geotechnical investigations are recommended for foundation construction because of possible low shear strengths in the till materials and the presence of underlying glaciolacustrine sediments which have poor geotechnical characteristics. In contrast, the sandy and stony tills found in the remainder of the map sheet have fairly good engineering characteristics. Excavations may have to contend with local bouldery areas. Where the till forms a thin mantle over the bedrock, blasting may be required in deeper excavations. The sandy till has generally good handling characteristics and can be used successfully as fill.

WASTE DISPOSAL: The deeper ground moraine deposits have potential for the disposal of both solid and liquid wastes. However, detailed hydrogeological studies would be required. If the ground moraine is present as a thin veneer over the bedrock, its suitability as a landfill site may be greatly reduced. In the northeastern part of the map-area, where clay till

predominates, there could be a problem with earth handling in landfill operations, especially during wet weather conditions. The clay till provides good target areas for lagoon sites. Conversely, the impermeable nature of these soils acts as a constraint in the construction and proper functioning of septic tile fields. In this case, a suitable fill material would have to be imported.

3.3 GLACIOFLUVIAL LANDFORMS:

3.3.1 Description:

Outwash (GO) occurs in the northwestern part of the map-area. The deposits are of limited size and have been mapped in association with organic materials or sandy lake plains. A sample, taken immediately west of Hoiles Creek on Highway 11, consisted of 11% sand, 85% silt, and 4% clay. The high silt content reflects the glaciolacustrine orgin of part of this landform. Typical map symbols depicting the outwash materials are:

$$\frac{\text{sGO(pOT)}}{\text{Lu-W}} \qquad \frac{\text{sGO,sLP/R(pOT)}}{\text{Lup-Dh(W)}}$$

In both cases, the outwash materials are sandy, as is the material in the lake plain deposit. The symbol (/R) indicates that bedrock is close to surface. The subordinate organic terrain landform shows that wet, compressible soil conditions, which would be unfavourable for construction, can exist within this unit. In each case, the relief is low and undulating and drainage varies from wet to dry on surface, but with a high water table.

Eskers (GE) in the Taradale area trend in a southwesterly direction. The esker ridges are generally 5 to 15 m in height but the esker east of Hoiles Creek, on the western margin of the map-area, is in the order of 20 to 25 m in thickness. A typical symbol identifying an esker on the map is

$$\frac{\text{sgGE}}{\text{Lnk-D}}$$

This signifies that the material comprising the esker is gravel to gravelly sand. Relief is less than 15 m and the topography is knobby and kettled. Surface drainage conditions are dry. A subsurface investigation by the

Ontario Ministry of Transportation and Communications at the intersection of Highway 11 and Hoiles Creek indicated that bedrock was overlain by 10.7 m of soft sand and silt with occasional dense gravel.

Another esker feature occurs near the settlement of Stevens, in the southwest corner of the map-area. This esker appears to consist mainly of fine to coarse gravelly sand with some patches of cobbly gravelly sand. Three small pits have been developed in this landform. Bedrock knobs are a subordinate landform and the floodplain of Lone Isle Creek traverses the unit. It is represented on the map by the symbol:

$$\frac{\text{sgGE(AP,RN)}}{\text{Ldk-D}}$$

Other small esker ridges are found throughout the map-area, but they are not plentiful. Buried eskers have been identified at one or two locations in the north-central part of the area. This suggests that there is potential for further buried eskers under the clay till.

Kames (GK) have been mapped in the south-central part of the area. They occur in association with eskers and correlate generally with the area mapped by Boissonneau (1965) as the White Otter Lake end moraine. The unit is depicted on the map by the symbol:

$$\frac{\text{sgGK(sgGE)}}{\text{Lnk-D}}$$

This signifies that the kames are composed of sand and gravel, relief is low, topography is knobby with occasional kettles, and drainage is dry. A subordinate esker consisting of sand and gravel occurs in association with the kame unit.

3.3.2 Significance:

RESOURCES: The glaciofluvial landforms provide the only resource potential for sand and gravel materials in the Taradale area. Because of the limited occurrence and extent of these deposits within the area, the sand and gravel potential, on a regional basis, is rated as only moderate to poor. The esker east of Hoiles Creek has the best potential, and contains a large pit, with a face height of 20 m, showing about 20% crushable

material. The White Otter River deposit shows some potential for commercial sand and gravel development, while the deposit at Stevens appears to have limited reserves.

Ground water potential within the glaciofluvial landforms is probably moderate to low, because the deposits are small in areal extent and are often quite shallow. An exception to this is the outwash-esker complex on the western margin of the map-area. Here, sand and gravel deposits are probably of sufficient thickness to have potential for development of local ground water supplies.

GENERAL CONSTRUCTION: Many of the glaciofluvial terrain units are complex, in that they also contain rock knobs, swamps, shallow bedrock, and alluvial plains. Because of this variability, construction conditions will also be variable. However, where deep sand and gravel occur, construction conditions should be good. The material will have acceptable handling qualities for general grading operations, and construction of foundations should present few problems. Excavations in these deposits may encounter variable conditions in some areas, but generally they should be relatively free from serious difficulties. Problems can be expected where bedrock is close to surface, where ground water levels are high, and where organic and alluvial landforms are found. Site-specific investigations are necessary prior to the design of all engineering activities.

WASTE DISPOSAL: The glaciofluvial terrain units in this map-area are not ideal for the disposal of either solid or liquid wastes. Overburden conditions can be complex. For example, there may be underlying unconfined aquifers or bedrock close to the surface. Therefore, any disposal of wastes, whether they be solid (industrial or domestic) or liquid effluents, would require detailed geotechnical investigations and possibly expensive engineering facilities to ensure that they do not contaminate either ground or surface water.

3.4 GLACIOLACUSTRINE LANDFORMS:

3.4.1 Description:

Glaciolacustrine lake plain deposits (LP) of variable thickness cover much of the Taradale area. It is believed that these sediments were deposited in Glacial Lake Barlow-Ojibway during the later recessional stages of

the last ice sheet. The deposits are thickest in the north-central part of the map-area and become thinner over bedrock in the central portion. They thicken again to the south and southeast. A generalized stratigraphic sequence might consist of, from bottom to top: bedrock, ground moraine, glaciolacustrine clay and silt, and occasionally organic terrain. This organic terrain is usually less than 1 m thick, but is sufficient to produce spruce bog forests and wet surface conditions.

A typical symbol depicting this terrain unit is:

$$\frac{\text{smLP,tMG/R(pOT,RN)}}{\text{Lup-N}}$$

The thicker lake plain sediments are composed of varved silt and clay, which grade to silt and fine sand close to the old shorelines. In some areas, small beach deposits have been noted and, in other areas, there are extensive off-shore terraces shown by the abandoned shoreline symbol on the Data Base Map (OGS Map 5082, accompanying this report). Two samples, taken from these lake plain deposits, showed high percentages of silt. One sample contained 6% sand, 65% silt, and 29% clay. Atterberg Limits indicate a liquid limit of 29 (American Society for Testing and Materials 1979a), a plastic limit of 17, and a plasticity index of 12 (American Society for Testing and Materials 1979b). According to the Unified Soil Classification System (United States Department of the Interior 1974), this is a soil of low to moderate plasticity. The other sample, which is typical of the varved silt component of the sediment, contained 94% silt and only 6% clay. This sample is non-plastic.

Symbols typical of the deeper sediments include:

$$\frac{\text{cmLP,pOT(RN)}}{\text{Lp-M}} \qquad \frac{\text{smLP(pOT)}}{\text{Lpu-D}}$$

In the central part of the map-area, where rock knob terrain is dominant, the lake plain deposits occur as a subordinate landform. Here, wave action of the glacial lakes, acting on the flanks of bedrock hills veneered with sandy till, resulted in the deposition of beach deposits. Such deposits are scattered throughout the map-area and are indicated by symbols such as:

$$\frac{\text{RN(tMG,sLP/R,pOT)}}{\text{Luw-M}}$$

3.4.2 Significance:

RESOURCES: The glaciolacustrine deposits have little aggregate resource significance because of the fine-grained nature of the soils. Where glacial lake action deposited beaches on the flanks of outcrops, there is the possibility of local sand and gravel deposits. A number of small pits have been opened in such beach deposits along Highway 11 in the middle of the map-area. These deposits are usually of limited size, and the material tends to have a high sand content and in some cases is dirty. The deposits often form only a thin veneer over bedrock and are generally only of local significance.

Ground water resources are not expected to be plentiful within the glaciolacustrine landforms due to the fine-grained nature of the sediments.

GENERAL CONSTRUCTION: Because the soils are fine grained, with a high percentage of silt, construction conditions are far from ideal. While the material should excavate easily, it will be difficult to handle and compact, especially during periods of wet weather. Poor drainage and the frost susceptible nature of the soil necessitate increased pavement designs for roads. The soils could have low shear strengths and foundations could be costly, especially where the deposits are deep.

WASTE DISPOSAL: The generally poor surface drainage conditions, the existence of organic materials, and the fine-grained nature of the soils make most of the glaciolacustrine areas unsuitable for siting of septic systems. These same conditions can present serious problems for siting of lagoons and sanitary landfills, particularly with respect to construction and possible contamination of surface and ground water resources. Detailed investigations should be conducted prior to development of any such facilities.

3.5 ORGANIC LANDFORMS:

3.5.1 Description:

Organic terrain (OT) is common throughout much of the Taradale area. Only the larger swamps have been indicated as dominant landforms on the Data Base Map (OGS Map 5082, accompanying this report). However, organic terrain is quite commonly found as a subordinate landform in association with the clay till and glaciolacustrine deposits. Where swamps

are the dominant landform, such as in the central part of the map-area, they overlie lake plain deposits. The water table is often at the surface in these swamps and the solid material is mainly peat.

A typical map symbol depicting a simple organic terrain unit is:

$$\frac{\text{pOT}}{\text{Lp-W}}$$

However, a complex unit is more common where the organic material forms a veneer over lake plain sediments. A typical symbol depicting such a unit is:

$$\frac{\text{pOT/sLP,sAP(cmLP)}}{\text{Lp-W(M)}}$$

In this case, a veneer of organic terrain overlies a sandy lake plain deposit and an alluvial plain forms a significant part of the unit. Silty clay lake plain deposits occur as a subordinate landform. The terrain is flat, of low relief, and is wet in areas of organic or alluvial materials. The subordinate lake plain has mixed drainage conditions.

3.5.2 Significance:

Organic terrain is far from ideal for any type of human activity. The highly compressible materials and poor drainage cause a number of serious development problems. Construction would have to contend with soft and compressible soils, adverse ground water conditions, and poor accessibility.

4.0 SUMMARY OF ENGINEERING SIGNIFICANCE:

The preceding section described the characteristics of the major landform types and the engineering and resource significance of these units. Table 1 is a summary of the general engineering significance of the more common terrain units found in the area. This table is intended only as a guide to help the reader in assessing the overall significance of the map-units. Site-specific work is necessary to better define actual ground conditions. Also, it must be realized that there are a number of conditions, such as drainage and slope, which are not considered in the table but which may affect the engineering significance of the various terrain units.

TABLE 1 SUMMARY OF ENGINEERING SIGNIFICANCE

		BEDROCK	MORAINAL		GLACIOFLUVIAL			GLACIOLACUSTRINE		ORGANIC
		RN(tMG/R)	tcMG	tMG/R	sGO(pOT)	sgGE	sgGK	sLP(pOT,RN)	cmLP/R(pOT,tMG,RN)	pOT
RESOURCE POTENTIAL	Sand & Gravel	Poor	Poor	Poor	Fair	Excellent	Excellent	Poor	Poor	Non-Existent
	Ground Water	Poor	Poor	Poor	Poor	Fair	Fair	Poor	Poor	Poor
	Excavation	Blasting	Good	Fair	Fair	Good	Good	Fair	Fair	Poor
LIGHT CONSTRUCTION CONDITIONS	Foundation	Excellent	Fair	Good	Fair	Good	Good	Fair	Fair	Very Poor
	Grading	Difficult	Fair	Fair	Good	Good	Good	Fair	Fair	Very Poor
	Material Re-Use	Rock Fill	Poor	Good	Fair	Good	Good	Poor	Poor	Very Poor
WASTE DISPOSAL SUITABILITY	Septic Systems	Very Poor	Fair	Fair	Fair to Good	Good	Good to Fair	Fair to Poor	Fair to Poor	Very Poor
	Landfill	Poor	Fair	Fair	Poor	Poor	Poor	Poor	Poor	Very Poor
	Lagoons	Very Poor	Good	Fair	Poor	Poor	Poor	Fair	Fair	Very Poor

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MAPS
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CARTES
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